



*California Environmental Technology
Certification Program*

Evaluation Report

Turner Designs

TD-4100 Fluorometer

October 2000



**CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
HAZARDOUS MATERIALS LABORATORY
ENVIRONMENTAL TECHNOLOGY CERTIFICATION PROGRAM**

TD-4100 On-Line Hydrocarbon Monitor

Turner Designs
Sunnyvale, California 94086
(<http://www.turnerdesigns.com>)

Contract Number 2000-T1932

EVALUATION REPORT (RECERTIFICATION)

October 2000

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FOREWORD

Effective January 1, 1994, Section 25200.1.5 of the California Health and Safety Code authorizes the State of California to certify the performance of environmental technologies that offer an environmental benefit. This includes measurement technologies. As part of this program, the State Department of Toxic Substances Control evaluated a continuous on-line fluorescence monitor, the Turner Designs TD-4100, for the detection of aromatic hydrocarbons in water. The evaluation and findings were described in a detailed report and the technology certified as of May 5, 1997 for a period of three years. The present report was prepared to document the Department's findings in response to the manufacturer's application to recertify the technology.

RE-CERTIFICATION OF TURNER DESIGNS TD-4100 ON-LINE HYDROCARBON MONITOR

Re-certification of the TD-4100 was requested by Turner Designs of Sunnyvale, California on 4 April 2000. Follow-up of this request was with the understanding that the TD-4100 remained in production unchanged and continued to meet the original performance claims. The following information was obtained during a site visit, through telephone interviews with long-term users of the TD-4100, and from additional documentation submitted by Turner Designs.

The facts to be ascertained were: (1) the TD-4100 continues to be manufactured as certified; (2) the quality of the product has been maintained or improved; (3) quality management and consumer support have been maintained.

As background information, Turner Designs management explained that the TD4100 had become a very successful product and that California Certification had been a major factor

in the product's acceptance. Specifically, the window-less design of the sample compartment was the breakthrough that made possible the design of a new type of hydrocarbon monitor that allowed the long-term monitoring of oil-containing waste streams with much less maintenance than was previously required. The California certification convinced distrustful customers that there was an instrument worth considering for the on-line monitoring for petroleum hydrocarbons in raw water or effluent streams. The Department in turn had been making available the Evaluation Report for the TD-4100 in PDF format and had dispatched it from time to time electronically in response to requests from potential users world-wide, usually within one hour of the request.

Turner Designs presented evaluation reports on the TD-4100 from the U.S. Coast Guard and the Canadian Water Research Institute (on behalf of Transport Canada). These successful evaluations included testing under conditions in seagoing vessels (vibration, operation in an inclined position) and have led to the acceptance of the TD-4100 in bilge-water monitoring on US and Canadian vessels. Calibration for the certification by Transport Canada was 0.01 to 9 ppm for fuel oil (light distillate) with concentrations of concern at or around 6 ppm; certification by the U.S. Coast Guard was at 15 ppm light distillate fuel oil, corresponding to the regulatory level enforced by that agency.

Another important application of the TD-4100 continues to be the monitoring of drinking water intakes in surface water sources. The City of Evansville, Indiana participated in the earlier evaluations and has continued to use the TD-4100 in its water supply intake structures on the Ohio River. The Donau Verbundplan (Danube Hydro)

at Vienna (Austria), after conducting additional testing uses the TD-4100 at its water supply wells along the Danube River. These and two other applications were confirmed in telephone interviews with users as described below.

Turner Designs' manufacturing facility continues to be housed in the same building as during the 1997 evaluation. The TD-4100 was presented both in its original and its "ruggedized" versions (with stainless-steel housing). Production facilities were maintained, calibrations, and quality checks were carried out and again demonstrated as they had been for the purpose of the original certification. All were found unchanged, except for the following improvement:

Turner Designs has developed solid calibration probes that are easily inserted into the light path when the sampling stream is turned off. Two such probes are available, they are intended for use with the excitation wavelengths appropriate for hydrocarbon monitoring as explained in the 1997 evaluation report. The probes contain a solid fluorescing target that can be increased or decreased in size by means of a set-screw and made to correspond to a specific detector response selected by the user. By inserting the probe from time to time, the operator is in a position to ascertain that the instrument electronics are working and are stable without the operator preparing a calibration liquid and pouring it through the sample compartment. The advantages of this approach are obvious, especially in the long-term monitoring of clean aqueous streams.

The functioning of the "zero" alarm was again demonstrated. This alarm is activated whenever the background reading decreases over time to prevent the instrument from losing sensitivity to pollutants in the monitored stream.

Using methodology that was developed and demonstrated during the earlier evaluation, Turner Designs has now accumulated a four-volume (as hard copy) database on the fluorescence excitation and emission wavelengths of wa-

terborne pollutants, actual raw waters, and actual waste streams, including quenching and other interfering substances. This database appears to comprise all of the known chemicals and source waters for which application of the TD4100 has ever been considered. Turner Designs no longer examines any potential user's samples but instead uses this database to estimate the utility of the TD-4100 for the potential user, based on data provided by the user in a written questionnaire. Based on these data and findings, Turner Designs then selects the best configuration of the TD-4100 to offer the user. For the user who offers to purchase the TD-4100, the company, as before, verifies actual performance of the TD-4100 using samples obtained from the user, before the instrument is delivered and installed by factory-trained personnel. This change in company policy was possible on the basis of experience gained during the years of commercial availability of the TD-4100.

The Company has applied to an accrediting body for comprehensive quality certification under ISO-9001 and expects certification in November 2000. Turner Designs' management demonstrated documentation prepared the company for this certification and demonstrated a computer database of consumer observations/complaints and the follow-up that these inquiries receive.

Turner Designs affixes a conspicuous decal with the California Certification logo to the TD-4100. A sample decal was obtained. It shows in clearly readable lettering the certification number and expiration data of the present certification.

Additional Supporting Materials Provided by Turner Designs, 4/4/00:

Customer Application Survey (6 pages); for completion by prospective user for

Turner Designs to determine suitability of TD-4100 for user's needs.

Hydrocarbons Evaluated for Fluorescence Detection by Turner Designs, 6 pages

Verbundplan (Austria) "Freudenau Power Station - Revitalisation and Management of Ground water in the city of Vienna." 4 pages.

Dreher, J.E. and Gunatilaka, A. 1996. A. Ground water management in the city of Vienna. *Int. J. Hydro Power & Dams*, 2: 545-554.

Turner Designs Quality Systems Manual. Document 4.2.M1, Rev. A, 5 pages of 13. Prepared for ISO 9001 certification. PROPRIETARY INFORMATION DRAFT.

Corrective Action Request/Preventive Action Request Procedure. Document 4.14.P1, Rev. 1, 3 pages. Prepared by Turner Designs for ISO 9001 certification, PROPRIETARY INFORMATION.

ISO 9001 Schedule, Updated 03/27/00. DRAFT - PROPRIETARY INFORMATION

Turner Designs - Hydrocarbon Business Group - Product Portfolio, 1 page

Turner Designs, Company Profile, 1 page

Turner Designs TD-4100, a low-maintenance, non-fouling, on-line monitor for hydrocarbons in water: The TD-4100., 4 pages

Turner Designs Solid Standards: Checkpoint. Solid calibration standards for the TD-360 fastHex, TD-3100, and TD-4100 series instruments, 1 page

Turner Designs Application Reports:

Monitoring Phenols in Water, August 1999, 1 page

Monitoring Crude Oil in Produced Water, April 1996, 1 page

Monitoring Oil in Cooling Water, April 1996, 1 page
Monitoring Leaks from Heat Exchangers, April 1996, 1 page

Petroleum Hydrocarbons in Wastewater, April 1996, 1 page

Monitoring Fuels in Stormwater Run-Off, April 1996, 1 page

Monitoring Hydrocarbons in Bilge Water, September 1999, 1 page

Monitoring Petroleum Hydrocarbons in Raw Drinking Water, February 2000, 1 p.

U.S. Department of Transportation, United States Coast Guard, Certificate of Approval of TD-4100 as Oil Content Meters, with testing report by Testing Engineers International, June 18, 1999

Transport Canada, Safety and Security, Marine Safety. Certification of TD-4100 as Oil Content Meter for bilge alarms as meeting the relevant requirements of the International Organization's (IMO) Resolution MECP.60(33), 13 January 1999

Government of Canada, Certificate regarding the above, specifying 5-15ppm alarm level, dated 12 Jan 1999.

Decal to affix to equipment, logo and text: California Environmental Protection Agency Certified Technology, TD-4100, Cert. #97-01-23, Exp. 5/5/2000. (2 decals).

USER REPORTS

Telephone Interviews were conducted with four major users of the TD-4100. They included two large-city water supply operations that use up to six TD-4100 instruments for hydrocarbon monitoring at raw water intakes along major rivers in the U.S.A. and central Europe. They are the City of Evansville, Indiana and Donauverbund, Vienna, Austria. The third user was a major municipal utility in the State of Alaska which has

employed the TD-4100 in the monitoring of a lubricating oil heat exchanger and a cooling tower. A major U.S. oil company's research and development branch has used the TD-4100 for about five years in process water control.

All users reported that the TD-4100 meets Turner Designs' specifications and works reliably with minimum maintenance. Calibration checks are conducted by these users weekly or monthly, with usually minimum or no adjustments of the instrument response. Calibrations were carried out less frequently, no more frequently than every month. All users expressed satisfaction both with the reliability of the TD-4100, and support by the manufacturer, noting that this support was rarely if ever needed.

CONCLUSION AND RECOMMENDATION

On the basis of these findings, re-certification of the TD-4100 is justified.

APPENDIX

The following Notice was published in the California Regulatory Notice Register Volume 2000, No.43-Z, p.1738-1741 of October 27, 2000:

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Final Decision to Re-Certify a Hazardous Waste Environmental Technology

The California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) hereby re-certifies the following company's hazardous waste environmental technology:

Turner Designs TD4100

On-Line Hydrocarbon Monitor

Chapter 412, Section 25200.1.5, Health and Safety Code (enacted by Assembly Bill 2060, 1993) authorizes the DTSC to certify the performance of hazardous waste environmental technologies. Hazardous waste environmental technologies are certified pursuant to implementing regulations found in Title 22 of the California Code of Regulations (CCR 22), Chapter 46, Section 68000. Only technologies that are determined not to pose a significant potential hazard to the public health and safety or to the environment when used under specified operating conditions may be certified. Incineration technologies are explicitly excluded from the certification program. The purpose of the certification program is to provide an in-depth, independent review of technologies at the manufacturer's level to facilitate regulatory and end-user acceptance and to promote and foster growth of California's environmental technology industry.

DTSC makes no express or implied warranties as to the performance of the manufacturer's product or equipment. The end-user is

solely responsible for complying with the applicable federal, state, and local regulatory requirements. Certification does not limit DTSC's authority to require additional measures for protection of the public health and the environment.

By accepting certification, the manufacturer assumes, for the duration of certification, responsibility for maintaining the quality of the manufactured equipment and materials at a level equal or better than was provided to obtain certification and agrees to be subject to quality monitoring by DTSC as required by the statute under which certification is granted.

DTSC's decision to certify was published in the California Regulatory Notice Register, volume 2000, No. 36-Z, pages 1493-1496 on September 8, 2000 and has been subject to public review and comment. Written comments were not received.

An Evaluation Report supporting the Department's decision is available for review at:

California Environmental Protection Agency, Department of Toxic Substances Control, Office of Pollution Prevention and Technology Development, P.O. Box 806, 301 Capitol Mall, 1st Floor, Sacramento, CA 95812-0806, Attn.: Dr. Ruth R. Chang, (510) 540-2651.

A description of the technology to be certified, the certification statement, and the certification limitations for the technology of the company listed above follows.

CERTIFICATION PROGRAM (AB2060) FOR HAZARDOUS WASTE ENVIRONMENTAL TECHNOLOGIES

TECHNOLOGY CERTIFICATION

Technology:

TD-4100 On-Line Hydrocarbon Monitor

Manufacturer:

Turner Designs, Inc., 845 West Maude Avenue, Sunnyvale, CA 94086, Tel. (408) 749-0994.

Technology Description

The technology is based on the principle of fluorescence detection in an aqueous stream irradiated with ultraviolet light from one of three available light sources. The light source generates UV or near-UV light that is passed through an excitation light filter chosen by the manufacturer. The selection of filters is based on information provided by the user regarding the characteristics and variability of the matrix and analytes of concern. The filtered excitation light enters a non-contact, non-fouling measurement cell containing a continuous-flow, laminar, free-falling aqueous stream. Any fluorescent compounds in the stream that can absorb the chosen wavelengths of excitation light, fluoresce at characteristic wavelengths. The fluorescence emissions pass through another filter, at 90 degrees from the excitation light, and are collected in a photomultiplier detector. A dual-beam optical design alternates between measurement of the filtered source light, dark current, and the filtered fluorescence emission light. Proprietary electronics convert the raw signal into readable units, displayed on an LCD screen as either fluo-

rescence units or concentration, or into a signal suitable as an input into a data logger. The compounds responsible for the signal are aromatic hydrocarbons of molecular weights ranging from benzene to polynuclear aromatics. Filtered excitation and fluorescence detection wavelengths, respectively, are for BTEX (including benzene), 254 nm and 280 nm, for gasoline, 254 and 330 nm, and for diesel fuel, 254 and 365 nm. The manufacturer also offers excitation and fluorescence filter sets for crude oil (wide band), 300-400 and 410-610 nm; and for crude oil (high blank condition), 300-400 and 400 nm. The excitation and fluorescence filters are interference filters which meet Turner Designs' specifications.

Certification Statement

Under the authority of Section 25200.1.5 of the California Health and Safety Code, the Department hereby certifies the TD-4100 On-line Fluorometer manufactured by Turner Designs, Inc., 845 West Maude Avenue, Sunnyvale, CA 94086 as a Measurement Technology for the continuous on-line monitoring of gasoline, benzene, toluene, ethyl benzene, xylenes (BTEX), and other petroleum products in water by virtue of their aromatic hydrocarbon content.

The TD-4100 is semi-quantitative in that it detects petroleum-derived products and pollutants in terms of a pre-set fluorescence level or in terms of levels set by calibration with benzene, gasoline, diesel, or other petroleum product. Detection levels in deionized water are about 1000 ppb for benzene and 5 ppb for diesel fuel or gasoline. In ambient and industrial waters, detection levels of 50 to 200 ppb are more typical. The dynamic range typically extends over three orders of magnitude. The relationship between concentration and fluorescence over this range is non-linear, although, for practical purposes, linearity ex-

tends between one and two orders of magnitude about chosen target levels. Within appropriate concentration ranges, comparison of fluorescence readings with results of laboratory analyses has shown correlation coefficients of 0.98 or better. The TD-4100 has been shown to be capable of maintaining a signal stable within about 5% over ten weeks.

A critical element of the technology is the manufacturer's commitment to match light source, excitation and fluorescence filters to a user's needs in terms of type of product to be detected, level of detection, and type and level of site-specific interferences (including interfering chemicals, changes in turbidity, or fluorescing particles such as algae), and establishment of an expected level of on-site performance based on these evaluations and prior to sale and installation of the equipment.

The use of a window-less measurement cell eliminates a principal source of signal attenuation. Stability of the signal is still dependent on the geometry of the sample stream, which is affected if a deposit is allowed to build up in the piping system leading to the measurement cell. Periodic calibration checks, replacement of the source lamps, and other maintenance must be performed by the user in a manner prescribed by the manufacturer.

The TD-4100 is equipped with alarm and signal circuits to allow the automatic interruption of an industrial inflow or effluent and alert the operator when a pre-set level of the target hydrocarbon is exceeded. As the signal may be affected by changes in temperature, the user must consider temperature changes in outdoor use.

The variability of the background and composition of the hydrocarbons being monitored will affect the sensitivity, accuracy, and precision of measurements. Differences

in aromatic content of gasolines may affect their detectability by fluorescence.

Limitations of Certification

The Department makes no express or implied warranties as to the performance of the manufacturer's product or equipment. The Department has not conducted any bench or field tests to confirm the manufacturer's performance data. Nor does the Department warrant that the manufacturer's product or equipment is free from any defects in workmanship or material caused by negligence, misuse, accident, or other causes.

The Department believes, however, that the manufacturer's product or equipment can achieve performance levels set out in this Certification. Said belief is based on a review of the data submitted by the manufacturer and other information, and is based on the use of the product in accordance with the manufacturer's specifications.

This certification is subject to the regulations found in Title 22 of the California Code of Regulations (CCR 22), Chapter 46, Section 68000, which include the duration of the Certification, the continued monitoring and oversight requirements, and the procedures for certification amendments and decertification.

By accepting this Certification, the manufacturer assumes for the duration of the Certification, responsibility for maintaining the quality of the manufactured materials and equipment at a level equal or better than was provided to obtain this Certification and agrees to be subject to quality monitoring by the Department as required by the law under which this Certification is granted.

Specific Conditions

The manufacturer shall use their established procedures to evaluate specific light source and

filter combinations so as to optimize instrument response relative to known, interfering substances that may occur at a customer's site. This includes consultation of a database of instrument responses to known analytes and sample streams and, for new waste streams, testing on samples of the actual waste streams at the manufacturer's facility. The manufacturer may substitute optical parts in response to monitoring requirements for specific sample streams. With regard to such substitutions, the conditions encountered during the evaluation on which this Certification is based shall remain representative of Turner Designs' response to customer needs and overall quality management.

All equipment shall be manufactured from materials with corrosion protection for outdoor use.

Turner Designs shall maintain their standards for ensuring that users receive applicable training in operation and maintenance of the technology.

Through updates of user guides, Manufacturer shall inform the user of interferences and matrix effects which potentially affect the testing results as they become known to the Manufacturer.

Certification does not extend to the users' construction of a sampling intake to obtain representative samples from high-flow streams of water or waste water and users' maintenance of such structures.

In cases where the results are to be reported as the concentration of a specific analyte, the user should calibrate the instrument using that analyte, and confirmatory results obtained using applicable U.S. EPA Office of Solid Waste SW-846 Test Methods.

Users shall provide the manufacturer with adequate information on the character-

istics and variability of their waste stream so that the manufacturer can properly configure and calibrate the instrument. Users shall follow the manufacturer's instructions for installation, operation, and maintenance. The user should be aware of potential changes in the characteristics of their waste streams that may affect the ability of the technology to detect the analytes of concern. Users shall develop and follow a plan in accordance with their facility's quality management system for validating, at appropriate intervals, the TD-4100 through sampling and laboratory analyses.

Basis for Certification

This re-certification is based on the finding that the technology certified effective 5 May 1997 has been maintained by the manufacturer in its original configuration and that the quality of the manufactured product and consumer services have been maintained at a level corresponding to or higher than was provided at the time of the original certification. Specifically, in 1999 the TD-4100 has been evaluated by the U.S. Coast Guard and Transport Canada and was certified for specific applications such as bilge water monitoring on seagoing vessels. The company is working towards ISO-9001 certification and maintains customer service documentation to meet ISO-9001 requirements. The company has also developed a family of straightforward yet innovative solid probes which make it quite easy to detect changes in electronic response during on-line operation of the TD-4100. The solid probe therefore facilitates maintenance and can be expected to increase reliability of the technology in field applications. A listing of the documentation available for this re-certification is contained in an amendment to the Evaluation Report. The manufacturer has declared that certain submitted materials contain proprietary information and should not be subject to public disclosure. Recent tele-

phone interviews of users, both nominated and not nominated by Turner Designs, showed a uniformly high level of satisfaction with the efficacy and reliability of the TD-4100 and the service provided by the company.

Recommended Applications

The Turner Designs TD-4100 fluorometer is intended for the continuous monitoring in the field or in industrial environments of aqueous streams containing petroleum fuels or other petroleum-derived pollutants. It allows automatic out-of-control alarms or signaling to shut down the monitored flow. Applications include preventing contamination of receiving waters with oily industrial effluents and storm water, and similar pollution of surface drinking water sources and groundwater. In most situations, and subject to those determinations which Turner Designs carries out in cooperation with each prospective user, the TD-4100 allows monitoring at or below regulatory levels.

The TD-4100 greatly improves the monitoring regime through its continuous operation, and may substantially reduce the need for periodic sampling, improve data quality, and add to the protection of public health and the environment. In case of an alarm, the TD-4100 can alert the operator so that immediate sampling of the monitored flow may be conducted to determine the nature of the offending pollutants.

Regulatory Implications

DTSC's certification does not change the regulatory status of hydrocarbon testing; it is intended, however, to facilitate and encourage the acceptance of this technology where a project's data quality objectives can be met by its use. To this end, regulatory programs are encouraged to consider the Department's

findings regarding this technology, depending on each program's objectives and constraint. State-regulated facilities may contact state permitting officers regarding the use of the technology for operational monitoring. Other local and state government permitting authorities may take this certification under consideration when making their permitting decisions. Project managers may consider using this technology where its use can contribute to the project and its data quality objectives.

Duration of Certification

This certification takes effect 30 days after the date of publication of this Notice. Unless amended or revoked for cause, this certification will remain in effect for three years.



California Environmental Technology Certification Program

The California Environmental Protection Agency (Cal/EPA) offers a voluntary certification program for manufacturers and developers of environmental technologies who claim that their product offers a benefit to the environment.

The California Environmental Technology Certification Program (CalCert) began operating in 1994 following the adoption of authorizing law that was championed by business, industry, academic, legal, financial, and public interest stakeholders. The program evaluates hazardous waste prevention, measurement and remediation, air pollution control, and water and wastewater treatment technologies.

CalCert offers participating technology manufacturers and developers an independent, recognized third-party evaluation of the performance or attributes of new and mature environmental technologies. The technologies, equipment, and products that are proven to work as claimed receive official state certification valid for a three-year period, with the ability to renew every three years. Companies participating in the program pay the costs of evaluating their data and certifying their technologies.

Cal/EPA has issued over 100 certificates for equipment, devices, and processes for measurement and monitoring, site characterization, pollution prevention, and waste treatment.

California environmental technology certification is assurance of:

technology performance...

competitive advantage...

and international recognition.

For more information, please contact:

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